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6. AUTHOR(S)
Pierre M. Petroff

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Materials Department
College of Engineering
University of California
Santa Barbara, CA 93106-5050

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13. ABSTRACT (Maximum 200 words)

Our research was focused on four topics that are aimed at a better understanding the physics and structural properties of quantum dots. We have demonstrated that the positioning and ordering of self assembled InAs/GaAs quantum dots (QDs) are possible using a localized strain engineering of the growth surface. Using micro-photoluminescence (Micro-PL) we have demonstrated a novel way of generating charged exciton states in QDs. A detailed understanding of the recombination processes involved with the various charged states excitons states has been obtained.

Using QDs in microdisk, we have demonstrated single heralded photon emission from a self assembled QD. By temperature tuning, we are able to shift the 1X exciton QD exciton into resonance with a whispering gallery mode of a microdisk and achieve turnstile of the coupled cavity –quantum dot system. We have shown that a QD is not only a source of correlated monochromatic photons but is also a source of multicolor photons with excitation power dependent correlation properties.

Our research on GaN QDs was aimed at developing the optimal growth conditions in the AlN/GaN system using molecular beam epitaxy (MBE). Optical spectroscopy of quantum dot ensembles was carried out and structures were developed to probe single GaN QDs using micro photoluminescence.

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ARO Contact: Dr. Henry Everitt

PI: Pierre Petroff
Materials department, University of California , Santa Barbara 93106
petroff @engineering.ucsb.edu

Ph.D graduate students: Chris Elsass (graduated), W.Schoenfeld (graduated), Antonio Badolato, Jay Brown.
MS graduate student: Jo Ann Johnson (graduated).
Postdoctoral researcher: Claus Metzner, Stefan Strauf.
International collaborations: Professor Jorg Kotthaus, Physics Department (University of Munich), Germany.
Professor David Gershoni, Physics department (Technion Institute of Technology), Israel.

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ABSTRACT:
To develop an improved quantum dot memory device, we have focused our research on four topics that are aimed at a better understanding the physics and structural properties of quantum dots. The topics we have covered are:
Structural properties of quantum dots:
This research has demonstrated that the positioning and ordering of self assembled InAs/GaAs quantum dots (QDs) are possible using a localized strain engineering of the growth surface.

Spectroscopy of charges quantum dots: We have focused on using micro-photoluminescence (Micro-PL) to understand thoroughly the photon emission properties of neutral and charged quantum dots (QDS). A novel way of generating charged exciton states in QDs has been developed. A detailed understanding of the recombination processes involved with the various charged states excitons states has been obtained.

Single photon emitters: These devices exploit the atomic like properties of the self assembled QDs. We have demonstrated single heralded photon emission from a self assembled QD. By temperature tuning, we are able to shift the 1X exciton QD exciton into resonance with a whispering gallery mode of a microdisk and achieve turnstile of the coupled cavity –quantum dot system. We also studied the intensity auto-correlation and cross correlation of two consecutively emitted photons from an optically excited single quantum dot. We have shown that a QD is not only a source of correlated monochromatic photons but is also a source of multicolor photons with excitation power dependent correlation properties. We found that the emitted photon statistic is evolving for increasing excitation power from a sub-Poissonian statistic, where the photons are temporarily antibunched to a super Poissonian one, where they are temporarily bunched.

GaN quantum dots: This research was aimed at developing the optimal growth conditions for GaN self assembled QDs in the AlN/GaN system using molecular beam epitaxy (MBE). Optical spectroscopy of quantum dot ensembles was carried out and structures were developed to probe single GaN QDs using micro photoluminescence.

RESEARCH ACCOMPLISHMENTS:

1) Structural properties of quantum dots (QDs):

One of the challenges in developing QDs devices is to electrically address the individual QDs forming the device. This is not possible with the usual MBE growth conditions for the InAs/GaAs QDs system where the QDs nucleate randomly on the surface. By patterning the surface using holographic lithography and regrowing on a patterned surface, we are able to engineer on a submicron scale the surface on which the QDs will be grown by MBE. The control achieved in positioning the individual QDs or groups of QDs is shown in Figure 1.

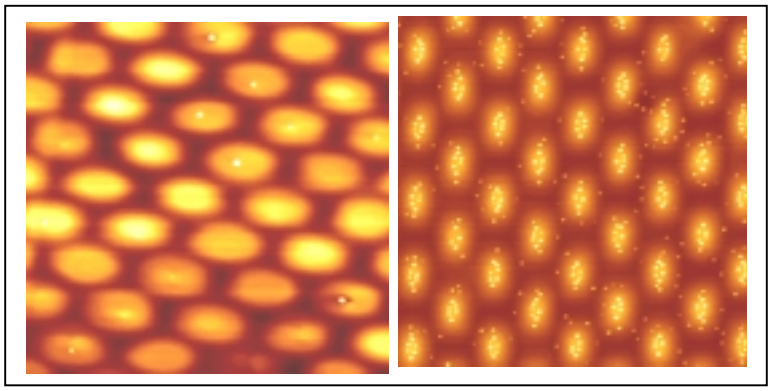

Figure 1: Atomic force micrographs of positioned InAs QDs on a patterned surface. The lattice periodicity is 0.5μm. The single QDs or groups of QDs are positioned on top of the mesas. The shape of the mesa and In flux allow to control the number and position of QDs on the mesas.

The micro photoluminescence (micro PL) properties of the single QDs has been analyzed and exhibits similar optical properties (See Fig. 2) as those obtained from single QDs obtained on flat GaAs substrates. A special cleaning procedure has been developed for cleaning the substrate after the patterning and prior to the regrowth of the QDs to minimize surface defects associated with the regrowth.

2) Spectroscopy of charged quantum dots:

To utilize the QDs in a device, whether it is a QDs memory or QDs laser or infrared detector, it is essential to thoroughly understand the optical properties of QDs. The QDs exhibit atom like properties because of the 3D carrier confinement. The charging of the QDs with carrier whether it is by electrical or optical carrier injection will most often results in the generation of negatively charged excitons X^- , $X^{--}$and X^{---}. We have investigated in detail the physics of the generation of the negatively charged excitons as well as the physics of their recombination processes. The results in Figure 2 show dramatic changes in the PL spectra generated by changes in the pump photon energy at a fixed excitation power. Two new lines red shifted relative to the ground state transition appear in the PL spectra. This effect is attributed to the non-equal population of electrons and holes which is generated by the excess energy of the photo-generated carriers. Based on a comparison of spectral positions of these 2 lines with a simple perturbation theory model, these new lines were identified as excitons complexes formed with one or 2 additional electrons (X^- and X^{--} excitons). We have demonstrated (see Fig.2) that the crucial role of excess energies of photo-generated carriers on the population of QDs with a non-equal number of electrons and holes could be used as an effective optical method for creating and studying charged excitons complexes in QDs.

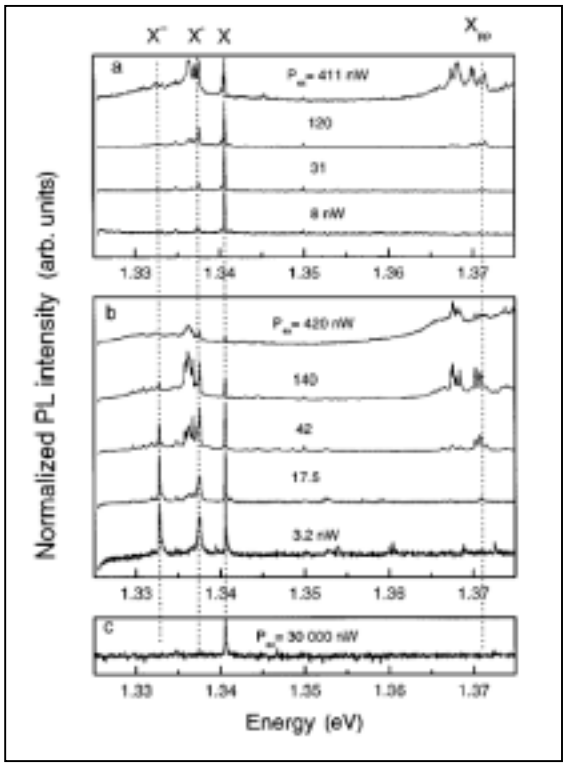

Figure 2: PL spectra of an individual QD at T=4K for a number of excitation powers P_{ex}(shown in the figure) and different pump photon energies. a) hν=1.684eV, b) hν= 1.536eV and c) hν= 1.433eV. All spectra are normalized to the maximum value of their PL amplitude and are vertically shifted for clarity.

We have also studied the charged exciton by electrical injection of electrons in QDs devices. We have also investigated the 2 possible states (the dark and bright state) of an exciton in a symmetric QD. These 2 states are separated in energy by the electron-hole exchange interaction. We have demonstrated that for a doubly charged exciton, there are 2 states split by the electron-hole exchange. We found that both states are now bright. We have uncovered a fine structure in the emission from the doubly charged and triply charged excitons as well as for the singly charged and doubly charged bi-excitons. Our approach allows measuring the electron hole exchange energy without having to break the symmetry of the QD. These results will be important in the generation of entangled states in optically excited QDs.

3) Quantum dots as single photon emitters:

This research again exploits the atomic like properties of the self assembled QDs. We studied the intensity auto- and cross- correlation functions of two consecutively emitted photons from a single excited semiconductor quantum dot. We have shown that a

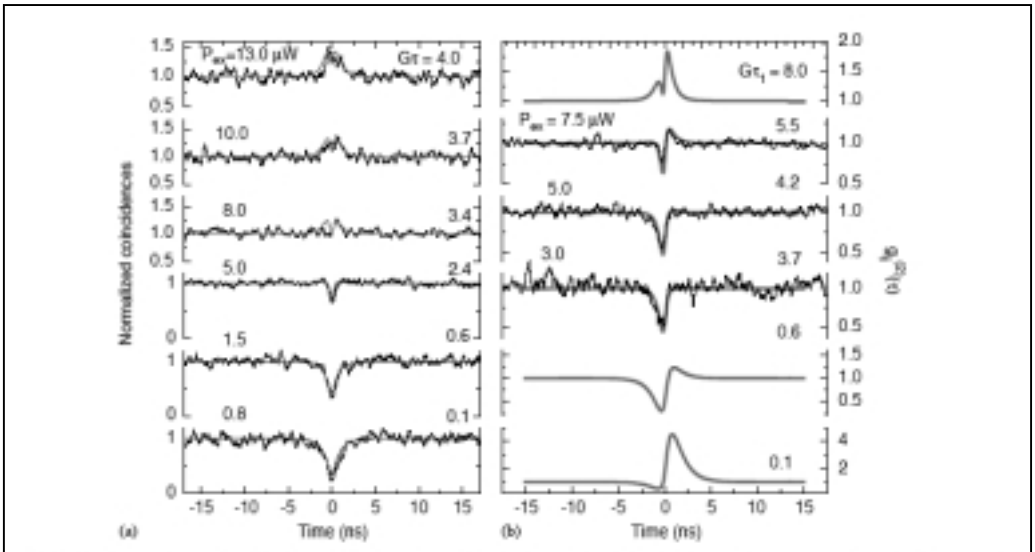

Fig. 3. (a) Measured (thick solid lines) and calculated (thin solid lines, see text) temporal intensity auto-correlation function of the X^0 spectral line for various excitation powers. (b) Measured and calculated temporal intensity cross-correlation function of the X^0 and aX^0 spectral lines for various excitation powers.

quantum dot is not only a source of non-classical light but it is also a source of multicolor photons with excitation and power dependent correlation properties.
We found the emitted photon statistics is evolving as the excitation power is increased from sub-Poissonian statistics where the photons are temporarily antibunched to a super Poissonian one where they are temporarily bunched. These findings may be very relevant when developing a QDs memory device in which the information is retrieved optically. We have also demonstrated single heralded photon emission from a self assembled QD. By temperature tuning, we are able to shift the 1X exciton QD exciton into resonance with a whispering gallery mode of a microdisk and achieve turnstile of the coupled cavity –quantum dot system.

4) GaN quantum dots:

To implement room temperature functional quantum dot devices we have developed the GaN/AlN quantum dot system. The GaN QDs are grown epitaxially using an rf-plasma MBE system. Again here our effort focused on obtaining samples with a controlled density of QDs to carry out single QD spectroscopy. The method uses the Stranski-Krastanov (S-K) growth mode on AlN (0001) by rf-plasma molecular beam epitaxy at 750 °C under Ga-droplet conditions. Accurate determination of the GaN growth rate by *ex-situ* high-resolution x-ray diffraction of GaN/AlGaN superlattices was utilized to calibrate the GaN coverage prior to desorption of excess Ga and formation of the GaN S-K islands under vacuum. The dependence of GaN S-K island density as a function of GaN coverage (for two growth rates: 0.10(±1.9%) and 0.23(±1.9%) monolayers per second), was obtained (see Fig 4) from atomic force microscopy and cross-sectional transmission electron microscopy. With a nitrogen-limited GaN growth rate of 0.23(±1.9%) monolayers per second, the GaN S-K island density was found to vary from less than 3×10^{8} to 9.2×10^{10} (cm^{-2}) as the GaN coverage was varied from 2.2 to 3.0

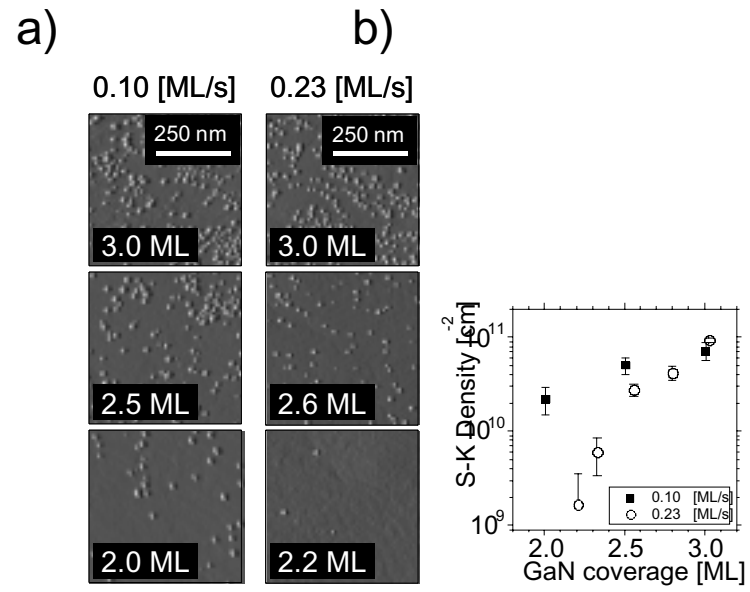

FIG 4: S-K island density for various GaN coverages for two GaN growth rates. (a) AFM (amplitude) micrographs of GaN S-K surfaces. (b) GaN S-K island density as a function of GaN coverage.

monolayers. Over the same range of GaN coverage, the mean Stranski-Krastanov island height was found to increase by approximately 12%. Figure 4 demonstrates our ability to vary the QDs density over 2 orders of magnitude as a function of the Ga deposition rate. We have carried out photoluminescence measurements on samples with a density of QDs $\approx 5\ 10^{10}cm^{-2}$. As expected the PL spectra (Fig 5) are broad reflecting the relatively large size distribution of the GaN QDs. The QDs have an average diameter of 30nm and average height of 3nm.

The QDs PL emission as a function of increasing temperature was observed to remain remarkably strong (Figure 5) up to 750K. The decrease of the PL emission above 400K was attributed to thermal ionization of deep levels in the AlN layer. Our attempt to measure the micro-PL of a single GaN QD have so far remained unsuccessful using a mesa structure in the high density region of the sample. We are currently attempting to use the low-density regions of the sample to obtain the micro-PL spectrum of a single QD at room temperature. For these experiments, we have developed a UVcompatible micro-PL systems with variable temperature.

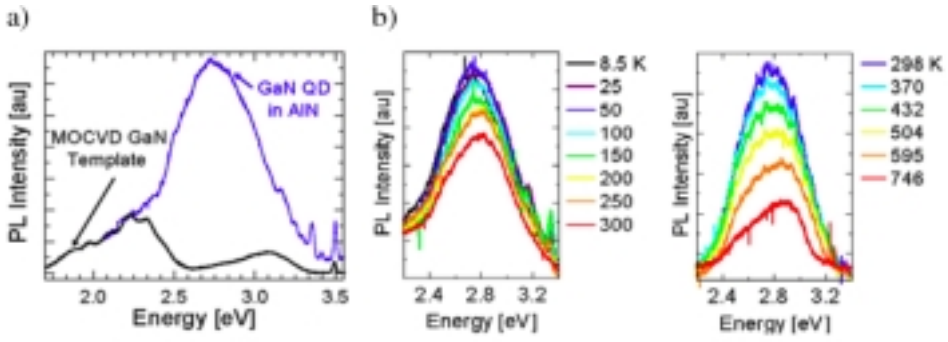

Figure 5 : a) Low temperature (50 K) PL (in arb. units) of GaN QD in AlN matrix and MOCVD-grown GaN on sapphire template. b) PL vs. temperature: low temperature (8.5–300 K) and high temperature (298–746 K) PL of GaN QD in AlN matrix

In summary the GaN QD PL emission is remarkably robust at room temperature and above. This may be attributed to the large conduction and valence band offsets between the GaN and the AlN. Suppressing the carrier thermal ionization out of the QDs will be useful in the development of room temperatures QDs devices.

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2000	A. Lorke, R. J. Luyken, A. O. Govorov, J. P. Kotthaus, J. M. Garcia, P. M. Petroff **"Spectroscopy of nanoscopic semiconductor rings"**	Physical Review Letters, V84 N10: 2223-2226
2000	R. J. Warburton, C. Schaflein, D. Haft, F. Bickel, A. Lorke, K. Karral, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Optical emission from a charge-tunable quantum ring"**	Nature, V405 N6789: 926-929
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2000	P. P. Paskov, P. O. Holtz, S. Wongmanerod, B. Monemar, J. M. Garcia, W. V. Shoenfeld, P. M. Petroff **"Auger processes in InAs self-assembled quantum dots"**	Physica E, V6 N1-4: 440-443
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2001	W. V. Schoenfeld, C. Metzner, E. Letts, P. M. Petroff **"Spectroscopy of strain-induced quantum dots in $GaAs/Al_xGa_{1-x}As$ quantum well structures"**	Phys. Rev. B, 6320, (no. 20), U416-U423
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2001	P. M. Petroff, A. Lorke, A. Imamoglu **"Epitaxially self-assembled quantum dots"**	Physics Today, 54, (no. 5), 46-52
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2001	R. Kegel, T. H. Metzger, A. Lorke, J. Peisl, J. Stangl, G. Bauer, K. Norlund, W. V. Schoenfeld, P. M. Petroff **"Determination of strain fields and composition of self-organized quantum dots using x-ray diffraction"**	Phys. Rev. B, 6303, (no. 3), U306-U317
2001	A. Lorke, R. J. Luyken, J. M. Garcia, P. M. Petroff **"Growth and electronic properties of self-organized quantum rings"**	Japanese Journal of Applied Physics, 40, part 1, (no. 3B), 1857-1895
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2001	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Influence of excitation energy on charged exciton formation in self-assembled InAs single quantum dots"**	Physical Review B, 64 (no. 8), 085302/1-6
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2002	P. M. Petroff, A. Lorke, A. Imamoglu **"Epitaxially Self-Assembled Quantum Dots"**	Physics Today (Japan), 17 (no. 3), 26-35
2002	A. Kiraz, S. Falth, C. Becher, B. Gayral, W. V. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu **"Photon correlation spectroscopy of a single quantum dot"**	Physical Review B, 6516 (no. 16), U41-U44
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2002	C. Shulhauser, D. Haft, C. Schaflein, K. Karrai, R. J. Warburton, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Giant permanent dipole moments of excitons in semiconductor nanostructures"**	Physica E, 13 (nos. 2-4), 161-164
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2002	D. V. Regelman, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Spectroscopy of positively and negatively charged quantum dots: wave function extent of holes and electrons"**	Physica E, 13 (nos. 2-4), 114-118
2002	K. F. Karlsson, E. S. Moskalenko, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"The influence of carrier diffusion on the formation of charged excitons in InAs/GaAs quantum dots"**	Physica E, 13 (nos. 2-4), 101-104

2002	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Acceptor-induced threshold energy for the optical charging of InAs single quantum dots"**	Physical Review B, 66 (no. 19), 195332-1-11
2002	C. Schulhauser, D. Haft, R. J. Warburton, K. Karrai, A. O. Govorov, A. V. Kalameitsev, A. Chaplik, W. Schoenfeld, J. M. Garcia, P. M. Petroff **"Magneto-optical properties of charged excitons in quantum dots"**	Physical Review B, 66 (no. 19), 193303-1-4
2002	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Formation of the charged exciton complexes in self-assembled InAs single quantum dots"**	Journal of Applied Physics, 92 (no. 11), 6787-6793
2002	B. Gayral, A. Kiraz, S. Falth, W. V. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu, C. Becher **"Cross-correlation spectroscopy in a single quantum dot"**	*Summaries of papers presented at the Quantum Electronics and Laser Science Conference* Optical Society of America, 1, 99-100
2002	C. Reese, B. Gayral, B. D. Gerardot, A. Kiraz, A. Imamoglu, P. M. Petroff, E. L. Hu **"Photonic crystal microcavities for cavity quantum electrodynamics"**	Proceedings of SPIE-The International Society for Optical Engineering, 4655, 215-220
2002	K. F. Karlsson, P. O. Holtz, E. S. Moskalenko, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Quantum dots as a sensitive tool to monitor charge"**	*14th Indium Phosphide and Related Materials Conference*. IEEE, 75-77
2003	P. M. Petroff **"Epitaxial growth and electronic structure of self-assembled quantum dots"**	Nanoscience and Technology Novel Structures and Phenomena (Editors Zikang Tang and Ping Sheng), Taylor & Francis Publishers, 61-79

2003	T. Heinzel, R. Jaggi, E. Ribeiro, M. Waldkirch, K. Ensslin, S. E. Ulloa, G. Medeiros-Ribeiro, P. M. Petroff **"Transport signatures of correlated disorder in a two-dimensional electron gas"**	Europhysics Letters, 61 (no. 5), 674-680
2003	A. Kiraz, C. Reese, B. Gayral, L. Zhang, W. V. Schoenfeld, B. D. Gerardot, P. M. Petroff, E. L. Hu, A. Imamoglu **"Cavity quantum electrodynamics with quantum dots"**	Journal of Optics B: Quantum and Semiclassical Optics, 5, 129-137

Work in Press:

2003	B. Urbaszek, R. J. Warburton, K. Karrai, B. D. Gerardot, P. M. Petroff, J. M. Garcia **"Fine structure of highly charged excitions in semiconductor quantum dots"**	Physical Review Letters
2003	P. M. Petroff **"Epitaxial growth and spectroscopy of semiconductor quantum dots"**	Single Quantum Dots, Topics Appl. Phys. 90 (Springer, Berlin, Heidelberg 2003) Editor: P. Michler, Springer
2003	U. Mizrahi, D. V. Regelman, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Tunable statistics of multicolor photons emitted from semiconducting quantum dots"**	Journal of Luminescence

List of oral presentations:

1. ***Invited Talk***. "Long range ordering in self-assembled quantum dots and tunable quantum dot molecules" EURESCO Conference on Fundamental Aspects of Surface Science : Epitaxial Growth and Nanostructures at Surfaces,: Castel Vecchio, Italy, October 2000
2. ***Invited Talk***. International workshop on applications of Synchrotron radiation Light sources. Self-Assembled Quantum Dot Lattices and Spectroscopy of Single Quantum Dot Molecules. *(Campinas Brazil . Ferbruary 2001).*
3. ***Invited talk:*** Self assembling quantum dot lattices and application of quantum dot coupling to a quantum dot memory device. *P. M. Petroff (Tsukuba Japan March 2001).*
4. ***Invited Talk :*** EMRS meeting. " Self-assembling quantum dot lattices and quantum dot resonant coupling. Petroff et al.. *(Strasbourg France June 2001)* .
5. ***Invited Talk****:* Self-assembled quantum dots and quantum dot molecules *(KITP general seminar UCSB November 2001).*
6. ***Invited Talk****:* American Association for the Advancement of Science. Symposium on Advanced and Novel Nanostructures: San Francisco, February 2000
7. ***Invited talk*** European MRS Symposium on Self-organization in Semiconductors-Fundamentals and Applications: Strasbourg, France, June 2001
8. ***Invited Talk****: Croucher lecture series* "Epitaxial growth and electronic structure of self assembled quantum dots ". *(Hong Kong, January 2002).*
9. ***Invited talk***: Nano 2002 international meeting." Towards controlling spin ordering in self assembled semiconductor quantum dots ". *(St Petersburg Russia 2002).*
10. ***Invited Talk:*** Physics Colloquium "Quantum dots as artificial atoms" , University of California, San Diego (May 2002).
11. ***Invited talk:*** NATO Advanced Workshop " Locating, confining and controlling electron spins in quantum dots. (Heraklion Crete June 2003).
12. "Quantum dot molecules as potential QBIT" American Chemical Society Meet Quantum Computing for the Next Millenium Symposium: Washington, D.C. September 2000

University of California, Santa Barbara
Bio-Bibliographic Update

This update refers to the period July 1, 2000 to June 30, 2003

Name: Pierre M. Petroff **Date:** June 10, 2003

Academic Title: Professor

Last Update Filed: October 2000

Graduate Degree Committees: Add any students missing

B. Gerardot	in progress	Chair	PhD
J. Johnson	2000	Chair	MS
C. Elsass	2002	Chair	PhD
Y. Chye	2001	Chair	PhD
A. Badolato	in progress	Chair	PhD
Lisa Kinder	In progress	Chair	PhD
M. White	in progress	Chair	PhD
J. Brown	in progress	Chair	PhD
F. Diana	in progress	Chair	PhD

Postdoctoral Scholars Supervised:

Name	Year
T. Lundstrom	1998-2000
H. Lee	1999-2000
A. Jaeger	1999-2000
C. Metzner	2000-2001
I. Schtrichman	2000-2002
V. Huard	2000-2001
S. Strauf	2002-2003

Patents:

Patent filled UC docket #: 30794.78WOU1 UC Case 2000-483	Strain-engineered, self-assembled, semiconductor quantum dot lattices. **H. Lee, J. A. Johnson, M. Y. He, J. S. Speck, P. M. Petroff**
Patent # 6,307,241 (2001)	Integrable ferromagnets for high density storage. **D. D. Awschalom, P. M. Petroff, J. Shi, J. M. Kikkawa**
Patent application filed UCLA case # 2002-498-1	Superlattice Nanopatterning (SNAP) of Wires and Complex Patterns**. N.Melosh, P.Petroff, J.Heath**
Patent # 6,541,788 (2003)	Strain-engineered Mid infrared and near infrared light upconverter using self-assembled quantum dots. **P. M. Petroff, H. Naoto**
Submitted June 2003	Fabrication method for arranging nanoparticles . **A.H.Lee, P.M.Petroff, E.Kramer**

Conference and talks for the period 2000-2003:

1. ***Invited Talk***. "Long range ordering in self-assembled quantum dots and tunable quantum dot molecules" EURESCO Conference on Fundamental Aspects of Surface Science : Epitaxial Growth and Nanostructures at Surfaces,: Castel Vecchio, Italy, October 2000
2. ***Invited Talk***. International workshop on applications of Synchrotron radiation Light sources. Self-Assembled Quantum Dot Lattices and Spectroscopy of Single Quantum Dot Molecules. *(Campinas Brazil . Ferbruary 2001).*
3. ***Invited talk:*** Self assembling quantum dot lattices and application of quantum dot coupling to a quantum dot memory device. *P. M. Petroff (Tsukuba Japan March 2001).*

4. ***Invited Talk :*** EMRS meeting. " Self-assembling quantum dot lattices and quantum dot resonant coupling. Petroff et al.. *(Strasbourg France June 2001)* .
5. ***Invited Talk:*** Self-assembled quantum dots and quantum dot molecules *(KITP general seminar UCSB November 2001).*
6. ***Invited Talk:*** American Association for the Advancement of Science. Symposium on Advanced and Novel Nanostructures: San Francisco, February 2000
7. ***Invited talk*** European MRS Symposium on Self-organization in Semiconductors-Fundamentals and Applications: Strasbourg, France, June 2001
8. ***Invited Talk****: Croucher lecture series "*Epitaxial growth and electronic structure of self assembled quantum dots ". *(Hong Kong, January 2002).*
9. ***Invited Talk:*** Physics Colloquium "Quantum dots as artificial atoms" , University of California, San Diego (May 2002).
10. ***Invited talk***: Nano 2002 international meeting." Towards controlling spin ordering in self assembled semiconductor quantum dots ". *(St Petersburg Russia 2002)*
11. ***Invited talk:*** NATO Advanced Workshop " Locating, confining and controlling electron spins in quantum dots. (Heraklion Crete June 2003).
12. "Quantum dot molecules as potential QBIT" American Chemical Society Meet Quantum Computing for the Next Millenium Symposium: Washington, D.C. September 2000
13. "Low temperature Fe/GaAs hybrid structures: growth and properties" American Vacuum Society meeting: Boston, MA, October 2000
14. March American Physical Society: "Fabrication of cobalt nanocrystals in inverse PS-PVP micelles by rapid pyrolysis and heat treatment" Frederic Diana, Seung-Heon Lee, Rachel Segalman, Pierre M. Petroff, and Edward J. Kramer *(APS March 2003).*
15. March American Physical society: "Self-assembly of nanoparticles into periodic" nanopatterns" Seung-Heon Lee, Frederic Diana, Antonio Badolato, Pierre M. Petroff and Edward J. Kramer *(UTA March 2003)*

PART IV. RESEARCH

Cumulative List of Publications: from July 2000 ***(the first author listed is the major contributor to the publication)***

323	2000	P. Michler, A. Kiraz, C. Becher, W. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu **"A quantum dot single turnstile device"**	Science, 290, p. 2282	Journal
324	2000	E. Dekel, D. Regelman, D. Gershoni, E. Ehrenfreund **"Cascade evolution and radiative recombination of quantum dot multiexcitons studied by time-resolved spectroscopy"**	Physical Review B, 62, (no. 16), pp.	Journal
325	2001	H. Lee, J.A. Johnson, M.Y. He, J.S. Speck, P.M. Petroff **"Strain engineered self-assembled semiconductor quantum dot lattices"**	Applied Physics Letters, 78, (no.1), 105-107	Journal
326	2001	A. E. Romanov, G. E. Beltz, W. T. Fischer, P. M. Petroff, J. S. Speck **"Elastic fields of quantum dots in subsurface layers"**	Journal of Applied Physics, 89, (no.8), 4523-4531,	Journal
327	2001	A. Kiraz, P. Michler, C. Becher, B. Gayral, A. Imamoglu, L. D. Zhang, E. Hu, W. V. Schoenfeld, P. M. Petroff **"Cavity-quantum electrodynamics using a single InAs quantum dot in a microdisk structure"**	Applied Physics Letters, 78, (no. 25), 3932-3934	Journal
328	2001	W. V. Schoenfeld, C. Metzner, E. Letts, P. M. Petroff **"Spectroscopy of strain-induced quantum dots in GaAs/$Al_xGa_{1-x}As$ quantum well structures"**	Phys. Rev. B, 6320, (no. 20), U416-U423	Journal
329	2001	A. Jaeger, P. M. Petroff, T. D. Lowes **"Angle dependent photocurrent spectroscopy of oxide-apertured vertical-cavity surface emitting lasers during aging"**	Applied Physics Letters, 78, (no. 20), 3012-3014	Journal

330	2001	D. Haft, R. J. Warburton, K. Karrai, S. Huant, G. Medeiros-Ribeiro, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Luminescence quenching in InAs quantum dots"**	Applied Physics Letters, 78, (no. 19), 2946-2948	Journal
331	2001	K. F. Karlsson, E. S. Moskalenko, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Temperature influence on optical charging of self-assembled InAs/GaAs semiconductor quantum dots"**	Applied Physics Letters, 78, (no. 19), 2952-2954	Journal
332	2001	P. Michler, A. Kiraz, C. Becher, L. D. Zhang, E. Hu, A. Imamoglu, W. V. Schoenfeld, P. M. Petroff **"Quantum dot lasers using high-Q microdisk cavities"**	Phys. Stat. Sol. B, 224, (no. 3), 797-801	Journal
333	2001	P. M. Petroff, A. Lorke, A. Imamoglu **"Epitaxially self-assembled quantum dots"**	Physics Today, 54, (no. 5), 46-52	Journal
334	2001	C. Reese, C. Becher, A. Imamoglu, E. Hu, B. D. Gerardot, P. M. Petroff **"Photonic crystal microcavities with self-assembled InAs quantum dots as active emitters"**	Applied Physics Letters, 78, (no. 16), 2279-2281	Journal
335	2001	D. V. Regelman, E. Dekel, D. Gershoni, W. V. Schoenfeld, P. M. Petroff **"Dynamics of excitons in single semiconductor quantum dots probed by time-resolved optical spectroscopy"**	Phys. Stat. Sol. B, 224, (no. 2), 343-348	Journal
336	2001	P. Boucad, K. S. Gill, J. B. Williams, M. S. Sherwin, W. V. Schoenfeld, P. M. Petroff **"Terahertz-frequency intraband absorption in semiconductor quantum dot molecules"**	Phys. Stat. Sol. B, 224, (no. 2), 443-446	Journal
337	2001	C. Becher, A. Kiraz, P. Michler, A. Imamoglu, W. V. Schoenfeld, P. M. Petroff, L. D. Zhang, E. Hu **"Nonclassical radiation from a single self-assembled InAs quantum dot"**	Phys. Rev. B, 6312, (no. 12), U53-U55	Journal

338	2001	R. J. Warburton, C. Schaflein, D. Haft, F. Bickel, A. Lorke, K. Karrai, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Optical emission from single, charge-tunable quantum rings"**	Physica E, 9, (no. 1), 124-130	Journal
339	2001	E. Dekel, D. V. Regelman, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Radiative lifetimes of single excitons in semiconductor quantum dots – manifestation of the spatial coherence effect"**	Solid State Communications, 117, (no. 7), 395-400	Journal
340	2001	R. J. Epstein, D. T. Fuchs, W. V. Schoenfeld, P. M. Petroff, D. D. Awschalom **"Hanle effect measurements of spin lifetimes in InAs self-assembled quantum dots"**	Applied Physics Letters, 78, (no. 6), 733-735	Journal
341	2001	R. Kegel, T. H. Metzger, A. Lorke, J. Peisl, J. Stangl, G. Bauer, K. Norlund, W. V. Schoenfeld, P. M. Petroff **"Determination of strain fields and composition of self-organized quantum dots using x-ray diffraction"**	Phys. Rev. B, 6303, (no. 3), U306-U317	Journal
342	2001	A. Lorke, R. J. Luyken, J. M. Garcia, P. M. Petroff **"Growth and electronic properties of self-organized quantum rings"**	Japanese Journal of Applied Physics, 40, part 1, (no. 3B), 1857-1895	Journal
343	2001	P. P. Paskov, P. O. Holtz, B. Monemar, J. M. Garcia, W. V. Schoenfeld, P. M. Petroff **"Excited state magnetoluminescence of InAs/GaAs self-assembled quantum dots"**	Japanese Journal of Applied Physics, 40, part 1, (no. 3B), 1998-2001	Journal
344	2001	C. R. Elsass, C. Poblenz, B. Heying, P. Fini, P. M. Petroff, S. P. DenBaars, U. K. Mishra, J. S. Speck **"Influence of Ga flux on the growth and electron transport properties of AlGaN/GaN heterostructures grown by plasma-assisted molecular beam epitaxy"**	Journal of Crystal Growth, 233 (no. 4), 709-716	Journal

345	2001	C. R. Elsass, C. Poblenz, B. Heying, P. Fini, P. M. Petroff, S. P. DenBaars, U. K. Mishra, J. S. Speck, A. Saxler, S. Elhamrib, W. C. Mitchel **"Influence of growth temperature and thickness of AlGaN caps on electron transport in AlGaN/GaN heterostructures grown by plasma-assisted molecular beam epitaxy"**	Japanese Journal of Applied Physics, 40, part 1, (no. 11), 6235-6238	Journal
346	2001	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Influence of excitation energy on charged exciton formation in self-assembled InAs single quantum dots"**	Physical Review B, 64 (no. 8), 085302/1-6	Journal
347	2001	J. Brown, C. Elsass, C. Poblenz, P. M. Petroff, J. S. Speck, **"Temperature dependent photoluminescence of MBE grown gallium nitride quantum dots"**	Physica Status Solidi B, 228 (no. 1), 199-202	Journal
348	2001	K. F. Karlsson, E. S. Moskalenko, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Carrier diffusion in the barrier enabling formation of charged excitons in InAs/GaAs quantum dots"**	Acta Physica Polonica A, 100 (no. 3), 387-395	Journal
349	2001	D. V. Regelman, E. Dekel, D. Gershoni, E. Ehrenfreund, A. J. Williamson, J. Shumway, A. Zunger, W. V. Schoenfeld, P. M. Petroff **"Optical spectroscopy of single quantum dots at tunable positive, neutral, and negative charge states"**	Physical Review B, 6416 (no. 16), 5301-U237-U242	Journal
350	2001	P. P. Paskov, P. O. Holtz, B. Monemar, J. M. Garcia, W. V. Schoenfeld, P. M. Petroff **"Optical up-conversion processes in InAs quantum dots"**	Japanese Journal of Applied Physics, 40 (no. 3B), 2080-2083	Journal
351	2001	D. V. Regelman, U. Mizrahi, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Semiconductor quantum dot: A quantum light source of multicolor photons with tunable statistics"**	Physical Review Letters, 8725 (no. 25), 7401-U165-U167	Journal

352	2001	C. Reese, B. Gayral, B. D. Gerardot, A. Imamoglu, P. M. Petroff, E. Hu, **"High-Q photonic crystal microcavities fabricated in a thin GaAs membrane"**	Journal of Vacuum Science & Technology B, 19 (no. 6), 2749-2752	Journal
353	2002	I. Shtrichman, C. Metzner, B. D. Gerardot, W. V. Schoenfeld, P. M. Petroff **"Photoluminescence of a single InAs quantum dot molecule under applied electric field"**	Physical Review B, 65, 081303-1-4	Journal
354	2002	Y. Chye, V. Huard, M. E. White, P. M. Petroff **"Properties of a Fe/GaAs (001) hybrid structure grown by molecular beam epitaxy"**	Applied Physics Letters, 80 (no. 3), 449-451	Journal
355	2002	P. Michler, A. Imamoglu, A. Kiraz, C. Becher, M. D. Mason, P. J. Carson, G. F. Strouse, S. K. Buratto, W. V. Schoenfeld, P. M. Petroff **"Nonclassical radiation from a single quantum dot"**	Physica Status Solid B, 229 (no. 1), 399-405	Journal
356	2002	P. M. Petroff, A. Lorke, A. Imamoglu **"Epitaxially Self-Assembled Quantum Dots"**	Physics Today (Japan), 17 (no. 3), 26-35	Journal
357	2002	R. J. Warburton, C. Schulhauser, D. Haft, C. Schaflein, K. Karrai, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Giant permanent dipole moments of excitons in semiconductor nanostructures"**	Physical Review B, 6511 (no. 11), U83-U86	Journal
358	2002	R. J. Epstein, I. Malajovich, R. K. Kawakami, Y. Chye, M. Hanson, P. M. Petroff, A. C. Gossard, D. D. Awschalom **"Spontaneous spin coherence in n-GaAs produced by ferromagnetic proximity polarization"**	Physical Review B, 6512 (no. 12), U23-U26	Journal
359	2002	A. Kiraz, S. Falth, C. Becher, B. Gayral, W. V. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu **"Photon correlation spectroscopy of a single quantum dot"**	Physical Review B, 6516 (no. 16), U41-U44	Journal

360	2002	M. K. K. Nakeama, M. J. S. P. Brasil, F. Iikawa, E. Ribeiro, T. Heinzel, K. Ensslin, G. Medeiros-Ribeiro, P. M. Petroff, J. A. Brum **"Micro-photoluminescence of self-assembled quantum dots in the presence of an electron gas"**	Physica E, 12 (no. 1-4), 872-875	Journal
361	2002	T. Heinzel, R. Jaggi, M. von Waldkirch, E. Ribeiro, K. Ensslin, S. E. Ulloa, G. Medeiros-Ribeiro, P. M. Petroff **"Transport signatures for correlated disorder in self-assembled quantum dots on GaAs"**	Physica E, 12 (no. 1-4), 591-594	Journal
362	2002	B. D. Gerardot, G. Subramanian, S. Minvielle, H. Lee, J. A. Johnson, W. V. Schoenfeld, D. Pine, J. S. Speck, P. M. Petroff **"Self-assembling quantum dot lattices through nucleation site engineering"**	Journal of Crystal Growth, 236 (no. 4), 647-654	Journal
363	2002	D. V. Regelman, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Spectroscopy of single semiconductor quantum dots at negative, neutral, and positive charge states"**	Physical Status Solidi A, 190 (no. 2), 491-497	Journal
364	2002	C. Becher, A. Kiraz, P. Michler, W. V. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu **"A quantum dot single-photon source"**	Physica E, 13, 412-417	Journal
365.	2002	R. J. Luyken, A. Lorke, G. M. Ribeiro, P. M. Petroff **"Charging dynamics in vertically aligned InAs quantum dots"**	Materials Science & Technology, 18 (no. 7), 725-728	Journal
366.	2002	Y. Chye, V. Huard, M. E. White, B. Gerardot, P. M. Petroff **"Optical property of Fe/GaAs (001) hybrid structures grown by molecular beam epitaxy"**	Physica E, 13 (nos. 2-4), 1135-1138	Journal
367.	2002	D. Haft, C. Schulhauser, A. O. Govorov, R. J. Warburton, K. Karrai, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Magneto-optical properties of ring-shaped self-assembled InGaAs quantum dots"**	Physica E, 13 (nos. 2-4), 165-169	Journal

368.	2002	C. Shulhauser, D. Haft, C. Schaflein, K. Karrai, R. J. Warburton, J. M. Garcia, W. Schoenfeld, P. M. Petroff **"Giant permanent dipole moments of excitons in semiconductor nanostructures"**	Physica E, 13 (nos. 2-4), 161-164	Journal
369.	2002	I. Shtrichman, C. Metzner, B. D. Gerardot, W. V. Schoenfeld, P. M. Petroff **"Optical spectroscopy of single quantum dot molecules under applied electric field"**	Physica E, 13 (nos. 2-4), 119-122	Journal
370.	2002	D. V. Regelman, D. Gershoni, E. Ehrenfreund, W. V. Schoenfeld, P. M. Petroff **"Spectroscopy of positively and negatively charged quantum dots: wave function extent of holes and electrons"**	Physica E, 13 (nos. 2-4), 114-118	Journal
371.	2002	K. F. Karlsson, E. S. Moskalenko, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"The influence of carrier diffusion on the formation of charged excitons in InAs/GaAs quantum dots"**	Physica E, 13 (nos. 2-4), 101-104	Journal
372.	2002	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Acceptor-induced threshold energy for the optical charging of InAs single quantum dots"**	Physical Review B, 66 (no. 19), 195332-1-11	Journal
373.	2002	C. Schulhauser, D. Haft, R. J. Warburton, K. Karrai, A. O. Govorov, A. V. Kalameitsev, A. Chaplik, W. Schoenfeld, J. M. Garcia, P. M. Petroff **"Magneto-optical properties of charged excitons in quantum dots"**	Physical Review B, 66 (no. 19), 193303-1-4	Journal
374.	2002	Y. Chye, M. E. White, E. Johnston-Halperin, B. D. Gerardot, D. D. Awschalom, P. M. Petroff **"Spin injection from (Ga,Mn)As into InAs quantum dots"**	Physical Review B, 66 (no. 20), 201301-1-4	Journal
375.	2002	E. S. Moskalenko, K. F. Karlsson, P. O. Holtz, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Formation of the charged exciton complexes in self-assembled InAs single quantum dots"**	Journal of Applied Physics, 92 (no. 11), 6787-6793	Journal

376.	2002	B. Gayral, A. Kiraz, S. Falth, W. V. Schoenfeld, P. M. Petroff, L. Zhang, E. Hu, A. Imamoglu, C. Becher **"Cross-correlation spectroscopy in a single quantum dot"**	*Summaries of papers presented at the Quantum Electronics and Laser Science Conference* Optical Society of America, 1, 99-100	Conference Proceeding
377.	2002	C. Reese, B. Gayral, B. D. Gerardot, A. Kiraz, A. Imamoglu, P. M. Petroff, E. L. Hu **"Photonic crystal microcavities for cavity quantum electrodynamics"**	Proceedings of SPIE-The International Society for Optical Engineering, 4655, 215-220	Conference Proceedings
378.	2002	D. Regalman, U. Mizrahi, W. V. Schoenfeld, P. M. Petroff **"Semiconductor quantum dot-a quantum light source of multicolor photons with tunable statistics"**	*Summaries of papers presented at the Quantum Electronics and Laser Science Conference*. Optical Society of America, 1, 21-22	Conference Proceedings
379.	2002	K. F. Karlsson, P. O. Holtz, E. S. Moskalenko, B. Monemar, W. V. Schoenfeld, J. M. Garcia, P. M. Petroff **"Quantum dots as a sensitive tool to monitor charge"**	*14th Indium Phosphide and Related Materials Conference*. IEEE, 75-77	Conference Proceedings
380.	2003	N. Melosh, A. Bookai, F. Diana, B. Gerardot, A. Badolato, P. M. Petroff, J. R. Heath **"Ultra high density nanowire lattices and circuits"**	Science, 300, 112-114	Journal
381.	2003	P. M. Petroff **"Epitaxial growth and electronic structure of self-assembled quantum dots"**	Nanoscience and Technology Novel Structures and Phenomena (Editors Zikang Tang and Ping Sheng), Taylor & Francis Publishers, 61-79	Book Chapter
382.	2003	T. Heinzel, R. Jaggi, E. Ribeiro, M. Waldkirch, K. Ensslin, S. E. Ulloa, G. Medeiros-Ribeiro, P. M. Petroff **"Transport signatures of correlated disorder in a two-dimensional electron gas"**	Europhysics Letters, 61 (no. 5), 674-680	Journal

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